

A new inversion routine to produce vertical electron-density profiles from ionospheric topside-sounder data (submitted to the Special Session on Ionospheric Sounder Methods and Measurements)

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Two software applications have been produced specifically for the analysis of some ½ million digital topside ionograms produced by a recent analog-to-digital conversion effort of selected analog telemetry tapes from the Alouette-2, ISIS-1 and ISIS-2 satellites. One, TOPIST (TOPside Ionogram Scalar with True-height algorithm) from the University of Massachusetts Lowell, is designed for the automatic identification of the topside-ionogram ionospheric-reflection traces and their inversion into vertical electron-density profiles $N_e(h)$. TOPIST also has the capability of manual intervention. The other application, from the Goddard Space Flight Center based on the FORTRAN code of John E. Jackson from the 1960s, is designed as an IDL-based interactive program for the scaling of selected digital topside-sounder ionograms. The Jackson code has also been modified, with some effort, so as to run on modern computers. This modification was motivated by the need to scale selected ionograms from the millions of Alouette/ISIS topside-sounder ionograms that only exist on 35-mm film. During this modification, it became evident that it would be more efficient to design a new code, based on the capabilities of present-day computers, than to continue to modify the old code. Such a new code has been produced and here we will describe its capabilities and compare $N_e(h)$ profiles produced from it with those produced by the Jackson code. The concept of the new code is to assume an initial $N_e(h)$ and derive a final $N_e(h)$ through an iteration process that makes the resulting apparent-height profile fit the scaled values within a certain error range. The new code can be used on the X-, O-, and Z-mode traces. It does not assume any predefined profile shape between two contiguous points, like the exponential rule used in Jackson's program. Instead, Monotone Piecewise Cubic Interpolation is applied in the global profile to keep the monotone nature of the profile, which also ensures better smoothness in the final profile than in Jackson's program. The new code uses the complete refractive index expression for a cold collisionless plasma and can accommodate the IGRF, T96, and other geomagnetic field models.